

- Sub  
ar
1. A method for recursive ray casting, the method comprising:
    2. providing a ray bundle of a selected position, direction and size;
    3. conducting a proximity test of a selected proximity at the selected position; and
    4. advancing the ray bundle a first casting distance when the proximity test is negative.
  - 5.
  6. The method of claim 1, wherein the first casting distance corresponds to the selected proximity.
  - 7.
  8. The method of claim 1, wherein the size of the ray bundle corresponds to the selected proximity.
  - 9.
  10. The method of claim 1, further comprising advancing a second casting distance when the proximity test is positive.
  - 11.
  12. The method of claim 1, further comprising retreating a second casting distance when the proximity test is positive.
  - 13.
  14. The method of claim 1, further comprising subdividing the ray bundle into child bundles when the proximity test is positive.
  - 15.
  16. The method of claim 6, further comprising traversing and subdividing until each child bundle is a single ray.
  - 17.
  - 18.
  - 19.
  - 20.
  - 21.
  - 22.
  - 23.
  - 24.
  - 25.
  - 26.

**BRIAN C. KUNZLER**  
ATTORNEY AT LAW  
10 WEST 100 SOUTH, SUITE 425  
SALT LAKE CITY, UTAH 84101

ପ୍ରକାଶକ ପତ୍ର

8. The method of claim 6, wherein subdividing comprises partitioning along the largest ray bundle dimension.
  9. The method of claim 6, wherein subdividing comprises partitioning along each ray bundle dimension.
  10. The method of claim 6, further comprising combining child bundles of a subdivided ray bundle when the proximity test of the ray bundle is negative.
  11. The method of claim 1, wherein the proximity test comprises testing boolean flags.
  12. The method of claim 1, wherein the proximity test comprises accessing a distance grid.
  13. The method of claim 1, wherein the proximity test comprises accessing a list of proximate objects.

- 1       14. A method for recursive ray casting, the method comprising:  
2                 providing a ray bundle of a selected position, direction and size;  
3                 conducting a proximity test of a selected proximity at the selected position;  
4                 advancing the ray bundle a first casting distance when the proximity test is  
5                 negative, the first casting distance and the size of the ray bundle corresponding to the  
6                 selected proximity;  
7                 retreating a second casting distance and subdividing the ray bundle into child  
8                 bundles when the proximity test is positive; and  
9                 advancing, subdividing and retreating until each child bundle is a single ray.
- 10  
11  
12       15. An apparatus for recursive ray casting, the apparatus comprising:  
13                 a proximity tester configured to receive a bundle position and provide a first hit  
14                 signal indicating whether the bundle position is proximate to a graphical object; and  
15                 a bundle caster configured to advance the bundle position.
- 16  
17  
18       16. The apparatus of claim 15, further comprising an occlusion detector operably  
19                 connected to the bundle caster, the occlusion detector configured to receive a pixel set  
20                 descriptor and a minimum z-depth, and to provide a mask indicating which pixels within  
21                 the pixel set are known to be occluded.
- 22  
23  
24       17. The apparatus of claim 16, wherein the pixel set is defined by an area selected  
25                 from a scanline span, a rectangle, and a triangle.
- 26  
27

1       18. The apparatus of claim 16, wherein the occlusion detector is configured to operate  
2 at a lower depth resolution than the bundle caster.

3

4       19. The apparatus of claim 15, wherein the bundle caster comprises at least one  
5 register file, each register file thereof coupled to an ALU.

6

7       20. The apparatus of claim 15, further comprising a collision tester configured to  
8 receive a ray position and provide a second hit signal indicating whether the ray position  
9 is on or within the graphical object.

10

11

12       21. The apparatus of claim 20, further comprising a ray caster configured to advance  
13 the ray position.

14

15

16       22. The apparatus of claim 21, wherein the ray caster comprises at least one register  
17 file, each register file thereof coupled to an ALU.

18

19

20       23. The apparatus of claim 22, wherein the ray caster is operably connected to the  
occlusion detector.

1           24. The apparatus of claim 23, wherein the occlusion detector comprises:  
2                   a z-buffer configured to store an occlusion depth for each of a plurality of pixels,  
3                   the occlusion depth being a low resolution representation of pixel depth;  
4                   a register configured to receive a pixel set descriptor describing a set of pixels  
5                   including a minimum depth for the set; and  
6                   a comparator configured to access the z-buffer and compare the minimum depth  
7                   with the occlusion depth for each pixel within the set of pixels.  
8  
9  
10

BRIAN C. KUNZLER  
ATTORNEY AT LAW  
10 WEST 100 SOUTH, SUITE 425  
SALT LAKE CITY, UTAH 84101